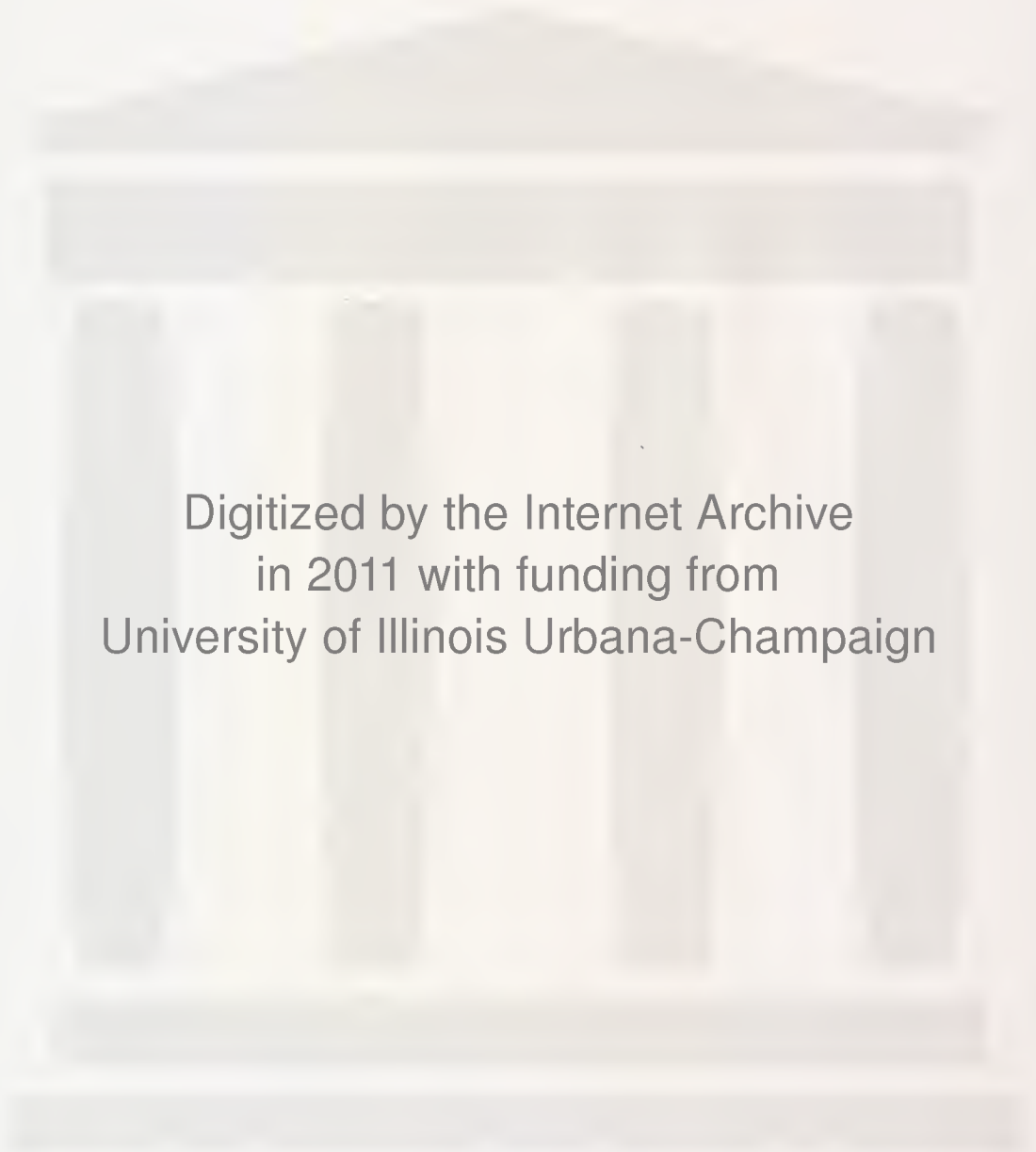

Faculty Working Papers

AUTOMATION, EMPLOYEE CENTRALITY IN THE PRODUCTION PROCESS, THE EXTENT TO WHICH ABSENCES CAN BE ANTICIPATED, AND THE RELATIONSHIP BETWEEN ABSENTEEISM AND OPERATING EFFICIENCY: AN EMPIRICAL ASSESSMENT

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College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

FACULTY WORKING PAPERS

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August 9, 1979

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Summary (Abstract) is on the next page.

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ABSTRACT

Despite almost universal agreement that employee absenteeism leads to decreased production efficiency, there is little documentation of a negative relationship between these variables. Recently, Staw and Oldham (1978) have even argued that absenteeism might lead to increased productivity, at least at the individual level of analysis. The present study hypothesizes and demonstrates that absenteeism and plant level efficiency are negatively associated 1) when production processes are not highly automated, 2) when those who are absent are central to the production process, and 3) when the absences cannot be anticipated in advance. Despite these limitations, the costs attributable to the impact of absenteeism on plant operating efficiency were substantial. If absenteeism is a function of employee satisfaction, quality of work programs designed to increase satisfaction are likely to result in considerable savings by increasing operating efficiency. This will be particularly true to the extent that they are conducted 1) in organizations in which human input is central and 2) on employees within these organizations who are central to the production process.

Proponents of programs designed to improve employee satisfaction and the quality of working life often claim that such efforts, if successful, will improve operating efficiency and effectiveness (e.g., Likert, 1961, 1967; Mills, 1975). An increasing amount of effort is being directed toward determining whether or not this is true and, if true, toward measuring the actual costs and benefits. Mirvis and Macy (1976) divide these efforts into asset models and cost models. Asset models consider human resources as corporate assets. Pyle (1970) suggests that assets invested in human resources may be treated like any other assets and evaluated on a cost-return basis. Asset models, however, do not deal adequately with employee effectiveness and performance on-the-job. Consequently, they are limited in their ability to assess the impact of employee morale on plant effectiveness and efficiency. Cost models, however, focus directly on employee behavior and attempt to evaluate the costs of behavior in dollar amounts. When these behaviors are associated with employee satisfaction and morale--e.g., absenteeism, turnover, tardiness--these costs can be viewed as variable, amenable to reduction with increased quality of work life.

Mirvis and Macy (1976) and Macy and Mirvis (1976) provide a good deal of evidence documenting the costs of behaviors often associated with employee morale, and they suggest that their evidence should stimulate quality of work programs. Recently, however, Staw and Oldham (1978) have argued that behaviors traditionally considered to be costly can, under some conditions, be beneficial to the organization. They report that for employees who are relatively dissatisfied with their jobs, absenteeism is positively not negatively associated with productivity.

Presumably, absenteeism relieves dissatisfied employees of job-related stress and allows them to be more productive when they return to work. Staw and Oldham point out that efficiency at the individual level may or may not be associated with organizational level performance. Absenteeism may be negatively rather than positively associated with overall organization effectiveness and efficiency. However, as will be noted below, even this is not as obvious as it may seem at first glance. The relationships between absenteeism, turnover, tardiness and other behaviors thought to be costly to organizations must be established through empirical research. This is particularly true when the assumption that the costs of these behaviors outweight their benefits guides policy decision-making (Willems, 1973). The present study, therefore, attempts to empirically assess the impact of one type of behavior, employee absenteeism, on organizational efficiency, the pounds produced and wasted per labor hour. In addition to Staw and Oldham (1978), several studies have failed to document a negative relationship between these variables (e.g., Seashore, Indik, & Georgopoulos, 1960; Turner, 1960; Argyle et al., 1958; Ronan, 1963). Most of these, however, focus on individual rather than organizational performance. The present study, in addition to considering organizational level performance, uses "hard" criterion measures and is based upon time series data gathered over a period of two years.

Absenteeism and Organization Efficiency: Some General Considerations

Macy and Mirvis (1976) identify several types of costs which can be associated with absenteeism. Fringe benefits or salary paid to absent

personnel, supervision time spent finding replacements or training new personnel, and unabsorbed overhead are just a few. These authors, like many others (Metzner & Mann, 1953; Morgan & Herman, 1976; Steers & Rhodes, 1978), also argue that absenteeism hinders operating effectiveness and efficiency. Mirvis and Lawler (1977) report that employee attitudes were associated with absenteeism in a midwestern bank. They also were associated with the frequency of teller shortages or overpayments to customers. While these authors did not report the relationship between absenteeism and teller shortages or overpayments, the covariation of absenteeism with attitudes and of attitudes with shortages suggests a positive relationship. Yet three considerations indicate that a positive association between absenteeism and lost effectiveness may not occur under all, and perhaps many, circumstances.

First, production methods used by industry often are designed precisely to avoid uncertainties associated with human operators. "Idiot proof" jobs deplored by many job design researchers may succeed in making many jobs "absentee proof." If standardized repetitive behaviors are all that is required and if sufficient control and "fail safe" systems are implemented, it may make little difference who is doing the job. So long as someone is present, the product may be produced effectively and efficiently. Organizations using highly automated technology requiring little human intervention and discretion may be relatively immune to negative effects of absenteeism among production personnel.

Such immunity, however, is not likely to extend to all personnel, and this suggests a second consideration. Who is absent is likely to be at least as important as the degree to which production processes

are automated. For example, the technical personnel required to keep automatic processes operating must be present if the processes are to be serviced and maintained. To generalize, absenteeism among personnel who are central to the production process is likely to have a greater impact on operating efficiency and effectiveness than is absenteeism among those who are less central.

The third consideration is that absenteeism is likely to have a negative effect on operating efficiency to the extent that it cannot be anticipated and planned for in advance. Illnesses, family problems, or other events seldom can be anticipated, and the organization has little time to find adequate replacements or to reschedule production. Other absences, such as vacations, however, can be anticipated well in advance and the organization can schedule staff and production to minimize if not eliminate production losses due to these absences.

These three considerations suggest that, despite almost universal agreement that absenteeism is associated with decreased production efficiency, the relationship between these variables is far from obvious. Organizations employing automated technology may suffer no losses from absences of production personnel. Organizations may suffer little loss from absences of peripheral personnel regardless of the technology they use, and the costs of absenteeism may be minimized or eliminated to the extent that it can be anticipated. These considerations do not go so far as Staw and Oldham (1978) in suggesting that absenteeism can, under some circumstances, be beneficial; however, they do indicate that the relationship between absenteeism and efficiency should be assessed empirically rather than simply assumed. Likewise, dollar costs of

absenteeism, to the extent that they exist, should be estimated empirically rather than simply relying on estimates by experts.

Study Site and Method

Absenteeism and efficiency data were gathered from an assembly and packaging plant employing approximately 750 persons. Well over half of the floor space and personnel were devoted to packaging. Assemblers prepared the material for packing, and maintenance personnel serviced the extensive conveying and packaging machinery. Approximately 450 employees were assigned to the assembly department. The plant employed about 90 maintenance personnel, including machinists, electricians, and other skilled tradespersons. There were about 130 assemblers. By far the most central activity, however, was packaging.

The packaging department was organized around several conveyors. Product being carried by these conveyors was packaged more or less automatically, depending upon the product and upon the line. Some products were packaged almost totally by hand. Other product was packaged almost totally by machines, never once coming in contact with a human hand. Conveyors often were converted to allow for packaging different products. There were, however, very few conversions on the most automated line. Production on this line came close to Woodward's (1965) description of continuous process flow.

Production plans were made weekly. Department superintendents attended weekly planning meetings where product goals would be established. They then would make personnel assignments. In the packaging department, most employees were assigned to different lines, depending upon

the production plan. While some people had more or less permanent positions, most fell into a common labor pool and would be assigned to different lines on different weeks. A high proportion of absenteeism in the packaging department as a whole therefore could affect production efficiency on all operating lines. The lines were, in this sense, characterized by pooled interdependence (Thompson, 1967); they all depended upon the common labor pool. It therefore was possible to select products for the efficiency analysis rather than rely upon an overall estimate which would include variance due to product mix.

Two products were selected on the basis of their comparability and the frequency--number of weeks--with which they were produced over the two year period of the study. The first product was a speciality item for the plant. It was produced almost continuously (N=103 weeks) on the most automated line described earlier. The second product, a non-specialty item, also was produced almost every week (N=101 weeks); however, production was less continuous than on the specialty line. Downtime due to packaging department product changes on the line which ran the non-specialty product averaged 3.35 hours per week. In contrast, an average of 0.20 packaging department hours were spent in downtime changing products on the line which ran the specialty product. The difference between these averages is statistically significant ($p < .05$), indicating that it was not due to vagaries of time sampling. While these two products differed substantially on the basis of the extent to which their production was automated, they were quite similar in other respects. In fact, when conversions were made on the automated line, the non-specialty product was one of the few which could be (and

was) produced on the line which usually ran the specialty product. Any differences in the relationship between pounds producted or wasted per labor hour and employee absenteeism for these two products therefore could plausibly be attributed to the difference in production automation rather than to differences in the nature of the product.

Data and Measures

Data on plant operating efficiency were gathered separately for each of the two products. Plant records were available for two one-year periods, January 1 to December 31, 1977 and April 1, 1978 to March 31, 1979.[1] The data gathered included the number of direct labor hours for both assembly and packaging which were allocated to each of the two products under investigation. They also included the number of pounds of each product produced for each week as well as the number of pounds refuse. Refuse included material which was broken and rejected; it was for all intents and purposes waste product.[2] Refuse pounds, pounds produced, and labor hours allocated for each product provided the efficiency measures used in this study. Data on the downtime due to changeovers discussed earlier were gathered from copies of the weekly production plans.

Absenteeism data were available for each of the weeks for which efficiency data had been gathered. It was possible to distinguish absences for each of the three major departments--packaging, assembly, and maintenance. It also was possible to distinguish among several different reasons for absences. Sickness, excused absences, and vacations were chosen for analysis, because they were both frequent and varied in terms of the degree to which they allowed the organization

to anticipate employees' lost time. Sicknesses were very difficult to anticipate. Excused absences infrequently were arranged in advance. Vacations could be anticipated weeks and sometimes months in advance. The number of days absent for each reason for each employee were summed for each week under study. These sums then were added to reflect the number of absent days for all employees for each of the three major departments for each of the three reasons for absences.[3]

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Insert Table 1 about here
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Means and standard deviations for the days absent for each reason for each department are presented in Table 1. Differences in averages across departments generally reflect differences in department size; however, it appears that maintenance personnel have a relatively higher incidence of excused absences and packaging personnel have a relatively lower incidence of vacation absences. The latter difference is probably due to the fact that vacation time was associated with seniority and packagers tended to be the least senior employees. Correlations among the absence variables are presented in Table 2. Here it is clear that vacation absences are associated across departments. While this reflects the fact that the organization can plan for and make adjustments to reduce costs associated with vacation absences, the magnitude of these correlations will make it difficult to separate out any effects of vacation absences in different departments.

Other patterns are evident in the data. Sickness and excused absences are significantly associated but only in the packaging department. Sickness absences are positively associated across departments, perhaps reflecting seasonal illnesses. Excused absences in packaging also covary with sickness absences in assembly and in maintenance, due in part to

Table 1

Descriptive Statistics Reflecting Number of Absent Days
by Department and by Reason for Absence
(N = 103 Weeks)

	$\bar{X}$ Days Absent	Standard Deviation
Packaging Department		
Sickness Absences	176.6	44.9
Excused Absences	12.8	5.1
Vacation Absences	138.4	52.7
Assembly Department		
Sickness Absences	22.6	6.7
Excused Absences	1.2	1.1
Vacation Absences	39.3	17.4
Maintenance Department		
Sickness Absences	13.1	6.2
Excused Absences	4.0	3.0
Vacation Absences	27.0	16.7

the association between illnesses and excused absences in packaging. When maintenance personnel are sick, relatively few take vacations ($r = -.40^*$, $p < .05$). This suggests that vacations may be distributed to adjust for illness absences; however this association was not evident in the packaging or assembly departments. None of these correlations, however, are so large as to preclude discriminating among the effects of absences by department or by reason. Only vacation absences across departments correlated highly enough to compromise clear cut discrimination.

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Insert Table 2 about here
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The Operational Model and Hypotheses

The general considerations discussed earlier guided the data gathering. The efficiency measures, pounds produced and pounds refuse per labor hour, assess organizational rather than individual level productivity. Likewise, the absenteeism data are aggregated to reflect departmental absenteeism. The packaging department is clearly the most central, at least for the less automated line, the line producing the non-specialty product. The maintenance department was more central for the more automated line because of the high degree of mechanization and because of the relatively minor--almost observer--role played by packaging personnel on this line. It was possible to anticipate and therefore plan for vacation absences; this was less true for excused absences and not at all the case for sicknesses. It therefore was expected that absences due to sicknesses and, perhaps, excused absences would have a greater impact on plant efficiency than would absences due to vacations.

Table 2

Pearson Product-Moment Correlations Among Measures of Absenteeism by Department and by Reason for Absence (N = 103 Weeks)

Packaging Department								
1. Sickness Absences								
2. Excused Absences	.23*							
3. Vacation Absences	.03	-.08						
Assembly Department								
4. Sickness Absences	.31*	.16*	.00					
5. Excused Absences	.02	-.05	-.08	.02				
6. Vacation Absences	-.01	-.01	.77*	.02	-.04			
Maintenance Department								
7. Sickness Absences	.34*	.21*	-.26*	.12	-.09	-.19*		
8. Excused Absences	.08	-.03	.17*	-.10	-.01	.12	-.12	
9. Vacation Absences	-.07	-.11	.83*	-.11	-.10	.71*	-.40*	.17*
	1	2	3	4	5	6	7	8

*$p \leq .05$

These considerations specify a rather complex model describing the relationship between absenteeism, labor hours, and pounds of product and refuse produced. Specifically, the impact of labor hours on pounds produced or rejected is seen to be a function of the level of absenteeism. Under conditions of high absenteeism, the slope reflecting the number of pounds produced per labor hour is expected to be greater under conditions (weeks) of low relative to high absenteeism. For pounds refuse, the relationship is expected to be reversed. The slope reflecting the number of pounds refuse per labor hour is viewed as being greater under conditions (weeks) of high as opposed to low absenteeism.

It also is expected that the impact of absenteeism will vary depending upon (1) the degree of automation in the production process, (2) the relative centrality (department) of those who are absent, and (3) the extent to which the absences can be anticipated. The expected interaction between absenteeism and labor hours as they effect pounds of product and refuse produced is therefore expected primarily, (1) when production procedures are not automated and the absences are those of central personnel (i.e., for the non-specialty product when packaging department absences are high), (2) when production procedures are automated and the absences are those of central personnel (i.e., for the specialty product when maintenance department absences are high), and (3) when the absences cannot be anticipated and planned for (i.e., when absences are due to sicknesses or excused reasons rather than vacations).

Tests for these interactions involved comparisons between models which did and did not allow for a differential impact of labor hours on pounds product and pounds refuse produced. To get a baseline assessment,

a model which did not specify absenteeism-labor hours interactions was estimated. This model took the following form:

$$Y = \alpha X_1 + \beta X_2 + \gamma X_3 + C \qquad (1)$$

where,

Y = pounds product or refuse produced

X_1 = labor hours assigned in packaging

X_2 = labor hours assigned in assembly

X_3 = number of days absent for one of the three reasons in one of the three departments[4]

C = a constant[5]

Once the coefficients in equation (1) had been estimated and a value for variance explained, $R^2(1)$, had been obtained, the data were run again. This time, however, they were run against a model allowing for separate estimates of the impact of labor hours for conditions of high versus low absenteeism. This model took the following form:

$$Y = \alpha_1 X_{1a} + \alpha_2 X_{1b} + \beta X_2 + \gamma X_3 + C \qquad (2)$$

where,

Y = pounds product or refuse produced

X_{1a} = labor hours assigned in packaging for weeks experiencing greater than average absenteeism for one of the three reasons for one of the three departments (low absenteeism weeks were coded zero on this variable)

X_{1b} = labor hours assigned in packaging for weeks experiencing less than average absenteeism for one of the three reasons for one of the three departments (high absenteeism weeks were coded zero on this variable)

X_2 = labor hours assigned in assembly

X_3 = number of days absent for one of the three reasons in one of the three departments

C = a constant.

Regression coefficients α_1 and α_2 in equation (2) provided independent estimates of the number of pounds product or refuse produced per labor hour under conditions of high versus low absenteeism for each department for each reason. Differences in estimates of the variance explained by equation (1), $R^2(1)$, and by equation (2), $R^2(2)$, provided a means for assessing the significance of the differences in slopes. Since,

$$\frac{R^2(2) - R^2(1)}{[1 - R^2(2)]/(\text{number of weeks} - 5)}$$

has an F distribution with 1 and the number of weeks - 5 degrees of freedom, the statistical significance of the difference in slopes for high versus low absenteeism could be assessed (Nie et al., 1975:389).

Initial regressions based upon equation (1) revealed substantial amounts of autocolinearity. Values of the Durbin-Watson d statistic tended to be very close to 1.0. Accordingly, the Cochrane-Orcutt technique was used to transform the measures to reduce correlation among first-order residuals (Johnston, 1963:192ff). The Durbin-Watson d estimated using the transformed data seldom was less than 2.0 for the subsequent regressions. Even then, d tended to be very close to 2.0.

RESULTS

Regression coefficients measuring pounds product produced per packaging department labor hour for weeks with high and with low absenteeism are presented in Tables 3 and 4.[6] It had been expected that sicknesses and excused absences in packaging would decrease pounds produced per packaging labor hour, especially for the non-specialty item.[7] The coefficients in Tables 3 and 4, however, show considerable stability

across conditions of low versus high packaging absenteeism. For whatever reason they are absent, absences in the packaging department do not appear to constrain pounds produced per labor hour for either product. The trend, in fact, is in the opposite direction. Perhaps packaging personnel who report in sick or have an excused absence are not replaced. Any losses in production, therefore, may be balanced by savings in terms of allocated labor hours. This, however, is unlikely. The plant maintains a pool of personnel from which replacements can be made on any particular line.[8] A more likely possibility is that production procedures for both products studied are sufficiently standardized that almost anyone can perform the production tasks and produce the prescribed amount of product. As will be seen below, however, they may not do so with equal amounts of refuse.

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Insert Tables 3 & 4 about here
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The results are somewhat different for absences in the maintenance department. The trend is reversed. As expected, with the exception of vacation absences, absences in the maintenance department are associated with higher levels of production per packaging labor hour. While these differences are substantial for the non-specialty product, they are statistically significant only in the case of the specialty product and for excused absences.

Since maintenance personnel are more central to production of the more automated specialty product, this relationship was expected. However, the effect of sickness absences for maintenance personnel also was expected. The relatively small difference in production per labor hour for high and low maintenance sickness absences may be due to differences in the quality of those who are absent. Those responsible

Table 3

Pounds Product Produced Per Labor Hour (Regression Coefficients)
by Absenteeism Level and Department for
Three Reasons for Absenteeism
(Specialty Product, N = 103 Weeks)

	Pounds Product Produced Per Labor Hour							
Reason for Absenteeism	Packaging Absenteeism Low		Packaging Absenteeism High		Assembly Absenteeism Low		Assembly Absenteeism High	
Sickness	107		108		111		109	
Excused	108		111		108		114	
Vacations	109		114		110		112	
	Maintenance Absenteeism Low		Maintenance Absenteeism High					
Sickness	108		107					
Excused	118	*	106					
Vacations	107		112					

*Difference between coefficients significant $p < .05$. Two tailed tests were used, because it was possible for absenteeism to actually increase pounds produced per labor hour. If employees were not replaced and those remaining performed the duties of those missing, pounds per hour would have increased rather than decreased as a result of absenteeism.

Table 4

Pounds Product Produced Per Labor Hour (Regression Coefficients) by Absenteeism Level and Department for Three Reasons for Absenteeism (Non-Specialty Product, N = 101 weeks)*

	Pounds Product Produced Per Labor Hour					
Reason for Absenteeism	Packaging Absenteeism		Assembly Absenteeism		Maintenance Absenteeism	
	Low	High	Low	High	Low	High
Sickness	297	295	297	311	317	295
Excused	294	315	297	307	300	282
Vacations	287	294	271	302	297	295

*Difference between coefficients significant, $p < .05$, two-tailed test.

enough to secure excuses--a procedure which, in this plant, can require documentation—may also be those who more responsibly fulfill their work duties. There is no documentation for this possibility, however, and it must remain speculative.

In sum, absenteeism among packaging personnel did not seem to affect the number of pounds of product per labor hour the department was able to produce. Absences among maintenance personnel, however, appear to be associated with fewer pounds of product produced per packaging labor hour. As expected, this effect is pronounced for the more automated specialty product; however, this is true only for excused absences. Vacation absences can be anticipated. There is no relationship between vacation absences and pounds product produced for either packaging or maintenance personnel. There is no relationship between absences in the assembly department and pounds product per labor hour for either product or for any of the three absence reasons. The absence of any relationship for assemblers provides support for the contention that centrality to the production process affects the impact of absenteeism on plant efficiency.

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Insert Tables 5 & 6 about here
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The number of pounds refuse per packaging labor hour for high and for low absence weeks by department and reason for absence are presented in Tables 5 and 6. Coefficients presented in these tables provide considerable support for the hypotheses. Trends for both products show the pounds refuse produced per packaging labor hour to be greater under conditions of high as opposed to low packaging absenteeism, except, as expected, for vacation absences. Also as expected, the relationship between absenteeism and pounds refuse per labor hour is particularly

Table 5

Pounds Refuse Produced Per Labor Hour (Regression Coefficients) by Absenteeism Level and Department for Three Reasons for Absenteeism (Specialty Product, N = 103 weeks)*

	Pounds Refuse Produced Per Labor Hour					
Reasons for Absenteeism	Packaging Absenteeism		Assembly Absenteeism		Maintenance Absenteeism	
	Low	High	Low	High	Low	High
Sickness	7.00	7.67	8.95	7.68	7.51	8.01
Excused	7.42	7.95	7.35	7.41	6.91	7.83
Vacations	7.42	7.76	8.36	6.61	8.05	6.96

*Difference between coefficients significant at $p < .05$ (one-tailed test).

Table 6

Pounds Refuse Produced Per Labor Hour (Regression Coefficients)
by Absenteeism Level and Department for
Three Reasons for Absenteeism
(Non-Specialty Product, N = 101 weeks)

	Pounds Refuse Produced Per Labor Hour								
Reasons for Absenteeism	Packaging Absenteeism			Assembly Absenteeism			Maintenance Absenteeism		
	Low		High	Low		High	Low		High
Sickness	1.00	*	2.93	0.93		0.40	-2.27	*	0.91
Excused	1.81	*	3.99	1.57		0.37	2.71		1.37
Vacations	1.88		1.85	1.57		1.71	1.81		0.80

*Difference between coefficients significant at $p < .05$ (one-tailed test).

pronounced and statistically significant only for the less automated non-specialty product. This relationship, as anticipated, holds only for sicknesses and excused absences. These absences were shown in Table 2 to be slightly but significantly associated ($r = .23$). It is unlikely that this small an association could completely account for the similarity in the patterns of coefficients; however, some confounding is possible. In any case the effect of these two absences is not seen in the case of vacations. In fact the direction is slightly reversed. It appears that while absences in the packaging department do not affect the pounds product produced per invested labor hour, they do increase the pounds refuse produced by the replacements for those who are absent. Vacation absences can be anticipated and planned for. These absences have little or no effect on the amount of product or refuse produced.

It had been expected that sicknesses and excused absences in the maintenance department would be associated with greater refuse per labor hour, particularly for the specialty product. The trends support the expectation that maintenance absences increase waste; however the only statistically significant relationship occurs with the non-specialty rather than with the specialty product.[9] While production of the non-specialty product is less automated than that of the specialty product, the non-specialty line is nonetheless highly mechanized. Maintenance personnel are required on both lines. It is possible that automation minimizes human errors and therefore that the impact of absenteeism on waste per labor hour will be minimal, even for those responsible for maintaining the equipment. None of the differences in Table 5 attain

statistical significance. The impact of absenteeism of both packaging and maintenance personnel, however, is evident in Table 6. Sickness absences across these departments were associated ($r = .34$), so some confounding is possible. However, packaging sickness also was associated with sickness absences in the assembly department and, as expected, the relationship between assembly department sickness or excused absences and waste per labor hour was not pronounced. In fact, the direction tends to be reversed, with low absence weeks showing greater refuse than high absence weeks. Also as expected, no substantial differences were evident for vacation absences.

SUMMARY AND DISCUSSION

It appears that the impact of absenteeism on operating efficiency occurs primarily to the extent that production is not automated. Excused absences in the maintenance department appeared to decrease pounds product per labor hour for the specialty product; however, maintenance absences were not significantly associated with refuse per labor hour for this more automated product. Besides reducing vulnerability to absenteeism of production personnel, automation may limit the impact of <u>any</u> absenteeism on waste. The only way absenteeism may affect operating efficiency when production is highly automated may be in terms of pounds product produced per invested labor hour and then only when maintenance personnel are absent for reasons which cannot be anticipated.

Less automated production seems to be more vulnerable to efficiency losses traceable to absenteeism. This vulnerability, however, seems focused on refuse rather than on pounds product per labor hour. This finding is similar to that reported by Seashore, Indik, and Georgopoulous

(1960). This plant, like many others, based its planning on weekly production goals. Because plans for product distribution required the plant to meet these goals, management had little freedom to vary the number of pounds product produced. The same number of pounds had to be produced, even if many key personnel were absent. The only degrees of freedom left to management, therefore, involved the speed of the line, the number of line-interruptions, or the number of personnel assigned to produce the product. Assigning additional personnel is costly. The labor union in this plant, as in others, was very sensitive about line speedups. The line of least resistance, therefore, may be to decrease the number of line interruptions. Lines may be stopped to make adjustments for product quality. They may be stopped, because mechanical problems may be decreasing the percentage of packageable product. These problems create refuse. Yet stopping the line would reduce the number of pounds of product produced and possibly keep the plant from meeting its production goals. The only cost-effective alternative may be to absorb costs in terms of higher refuse in order to avoid costs associated with the underutilization of distribution facilities and, perhaps, decreased sales and a permanent loss of customers.

If this sort of tradeoff occurs, it would explain why absenteeism appears to be more highly related to the production of waste than to the number of pounds produced. Relatively inexperienced personnel must produce the same amount of product as their more proficient counterparts. In the process, quality is likely to suffer and refuse accumulate. This will happen, however, only to the extent that production is not highly automated and the

absences cannot be anticipated. The absences also must be those of personnel central to the production process. More refuse per packaging labor hour was produced during weeks of high packaging absences for sicknesses and for excused reasons than during weeks of relatively low absenteeism. Sicknesses in the maintenance department were also associated with more refuse produced. These effects, however, occurred only for the less-automated non-specialty product. No relationship between absenteeism and refuse was documented for the more automated specialty product, and no relationship was evident between absenteeism in the less central assembly department and refuse.

Production of both the products studied here was highly mechanized. Prcduction of the specialty product is best characterized as continuous process flow (Woodward, 1965). Even a high degree of mechanization, however, does not appear to have insulated production of the non-specialty product from the effects of absenteeism on operating efficiency. For example, the difference in pounds of non-specialty product refuse produced during high versus low packaging sicknesses is 1.93 pounds per labor hour. An average of 462 packaging department hours were allocated to this product every week. This means that 1.93 x 462 = 892 more pounds of this product were lost to refuse during high as opposed to low absenteeism weeks. Exactly half of the weeks studied were above average in packaging sickness absenteeism. Sickness absenteeism, therefore, may be held responsible for 892 x 50.5 = 45,046 pounds of this product lost due to sickness absenteeism during the course of the study. This product retails for approximately $.85 for a half pound container. If 5% of this cost represents retail mark-up and 25% represents transportation and the costs of packaging materials, then each pound lost to

refuse represents (.85 x 2).70 = $1.19 lost income. This totals 45,046 x $1.19 = $53,605 lost due to sicknesses in the packaging department during the course of the study. This does not include the effect of excused absence or illnesses in the maintenance department; although the effects of these factors are confounded with those of packaging sicknesses. It also does not include the costs of these absences which were absorbed by other products and other lines. When variable costs of absenteeism other than production efficiency such as fringe benefits paid out, costs associated with maintaining a labor pool sufficient to provide replacements, etc., the costs of absenteeism total much higher than the $26,803 annually lost on the non-specialty product for sickness absences in packaging. Aggregated to the national level, the estimate of $26.4 billion (Steers & Rhodes, 1978) annually therefore may not be out of line. These calculations indicate that, if they are successful, programs such as quality of work life experiments designed to reduce absenteeism will result in considerable savings.

The findings suggest some strategies which could increase the impact of quality of working life programs on operating efficiency. For example, by increasing cooperativeness and trust, a greater proportion of absences might be anticipated and planned for in advance. Employees who know they will be absent may be willing to communicate this in advance to the extent that they are concerned with plant efficiency and feel they will not be punished for being absent for what may be a reason which is difficult to justify. The data suggest that knowing about absences in advance is just as effective as preventing them, at least in terms of minimizing their impact on operating efficiency. Secondly,

quality of work programs might usefully begin by focusing upon those who are central to the production process. Certainly, programs directed primarily toward more peripheral personnel cannot hope to secure the rate of benefits suggested here. Third, programs directed toward reducing absenteeism in order to increase operating efficiency are likely to be more effective in less automated settings where human input explains a substantial portion of the variance in efficiency.

The present study documents some gains and losses attributable to absenteeism of employees who perform different functions in the organization. The approach avoids problems associated with supervisor ratings of effectiveness by using time series data and "hard" criterion measures. However, there is no reason why this approach cannot be used to assess the impact of a less tangible factor, that of employee satisfaction on production efficiency. It has often been argued that such an association exists; however, it has been very difficult to document (Brayfield & Crockett, 1955; Vroom, 1964; Schwab & Cummings, 1970). It is possible that the degree to which work procedures are automated or even standardized, the extent to which the satisfied employees play a central role in the production process, and other constraints which limit the extent to which employees' can affect overall production efficiency may account for some of the inconsistent or inconclusive findings. There is no reason, however, why time series data cannot be used to compare plant level performance for weeks when central personnel who report high levels of satisfaction are present versus weeks when they tend to be absent. Such a comparison may show greater efficiency for weeks when the satisfied personnel are present rather than absent. At least to

the extent that production is not highly automated. The same procedure may be employed to investigate the effects of other factors, such as role stress, intrinsic motivation, job involvement, etc. This procedur would more closely tie productivity to employee attitudes <u>through</u> employee behaviors than has generally been done in the past (e.g., Likert and Bowers, 1973). Until this is done, however, the present study indicates that, to the extent that they lead to lower sickness and excused absence rates, employee attitudes will increase organizational performance.

FOOTNOTES

[1]Records were kept for 12 months, then discarded. When the researchers arrived at the site in mid April, 1979, to gather the second year data, data from January 1 to March 31, 1978 had been destroyed.

[2]Some material was recyclable. These pounds were not included as either production or refuse.

[3]In studies relating absenteeism to employee attitudes, the number of absences rather than the number of days absent is usually preferred (Chadwick-Jones et al., 1971; Huse & Taylor, 1962; Metzner & Mann, 1973). However, lost production efficiency, if there is any, is likely to be due to the fact that the needed individual is absent on a particular day. The frequency of sicknesses, excused absences, or vacations is likely to be less salient. Accordingly, the number of days absent rather than the frequency of absences was calculated.

[4]Due to the limited number of weeks available for analysis, it was not possible to assess the absenteeism-labor hour interaction simultaneously for all absence types (reasons by departments). Testing for interactions one absence type at a time is justified, given the generally low correlations among absenteeism measures. Possible limitations of this procedure are further minimized by the fact, to be shown later, that the only absence types to be highly correlated (vacations across departments) did not affect pounds product or refuse per labor hour. Where confounding is possible, however, it is discussed in the text.

[5]The constant was included for three reasons. First, there appeared to be a minimum number of pounds--product and refuse--that could be produced with maximum (or minimum) feasible absenteeism. Second, it was necessary to focus on what Macy and Mirvis (1976) call variable costs, those which can be affected by individual behaviors. These costs in pounds would be those above the minimum, given maximum (or minimum) feasible absenteeism. Third, it is conceivable that competitors of the plant could identify it as the subject of this research. They also might identify the products under study. If this were to happen, competitors would obtain valuable information concerning operating efficiency. Addition of the constant term precludes this possibility, and for this reason the values of these terms will not be reported here.

[6]All regresesions were statistically significant, $p < .05$. The number of days absent seldom had a significant main effect on pounds product or refuse produced. Only coefficients for two absence types were statistically significant ($p < .05$; one positive the other negative), just about the number expected by chance -1.8.

[7]Differences in regression coefficients across the tables are due to differences in the nature (e.g., weight) of the products and in production methods.

[8]This is a cost of absenteeism which is not under investigation here.

[9]It is particularly interesting that increasing the number of labor hours actually may reduce pounds refuse under conditions of low sickness absenteeism in the maintenance department. If refuse is not created by workers operating faulty machines, it seems plausible that the addition of workers to tend properly functioning equipment could actually reduce errors and waste.

REFERENCES

Argle, M., G. Gardner, and F. Cioffi
1958 "Supervisory Methods Related to Productivity, Absenteeism, and Labor Turnover." Human Relations, 11:23-40.

Brayfield, A. H. and W. H. Crockett
1955 "Employee Attitudes and Employee Performance." Psychological Bulletin, 52:396-424.

Chadwick-Jones, J. K., C. A. Brown, N. Nicholson and C. Sheppard
1971 "Absence Measures: Their Reliability and Stability in an Industrial Setting." Personnel Psychology, 24: 463-470.

Huse, E. F., and E. K. Taylor
1962 "The Reliability of Absence Measures." Journal of Applied Psychology, 46:159-160.

Johnston, J.
1963 Econometric Methods. New York: McGraw-Hill.

Likert, Rensis
1961 New Patterns of Management. New York: McGraw-Hill.

Likert, Rensis
1967 The Human Organization: Its Management and Value. New York: McGraw-Hill.

Likert, Rensis and D. Bowers
1973 "Improving the Accuracy of P/6 Reports by Estimating the Change in Dollar Value of the Human Organization." Michigan Business Review, 25:15-24.

Macy, B. A., and P. H. Mirvis
1976 "Measuring Quality of Work and Organizational Effectiveness in Behavioral-Economic Terms." Administrative Science Quarterly, 21:212-226.

Metzner, H., and F. Mann
1953 "Employee Attitudes and Absences." Personnel Psychology, 6:467-485.

Mills, Ted
1975 "Human Resources--Why the New Concern." Harvard Business Review, 53:_____.

Mirvis, P. H., and E. E. Lawler III
1977 "Measuring the Financial Impact of Employee Attitudes." Journal of Applied Psychology, 62:1-8.

Mirvis, P. H., and Barry Macy
1976 "Human Resource Accounting: A Measurement Perspective." Academy of Management Review, 1:74-83.

Morgan, L. G., and J. B. Herman
1976 "Perceived Consequences of Absenteeism." Journal of Applied Psychology, 61:738-742.

Nie, Norman H., C. Hadlai Hull, J. Jenkins, K. Steinbrenner, and D. H. Bent
1975 Statistical Package for the Social Sciences, 2nd edition. New York: McGraw-Hill.

Pyle, W.
1970 "Monitoring Human Resources--On Line." Michigan Business Review, 19-32.

Ronan, W. W.
1963 "A Factor Analysis of Eight Job Performance Measures." Journal of Industrial Psychology, 1:107-112.

Schwab, D. P., and L. L. Cummings
1970 "Theories of Performance and Satisfaction: A Review." Industrial Relations, 9:408-430.

Seashore, S. E., B. P. Indik, and B. S. Georgopoulos
1960 "Relationships Among Criteria of Job Performance." Journal of Applied Psychology, 44:195-202.

Staw, Barry M., and Greg R. Oldham
1978 "Reconsidering Our Dependent Variables: A Critique and Empirical Study." Academy of Management Journal, 21: 539-559.

Steers, Richard M., and Susan R. Rhodes
1978 "Major Influences on Employee Attendance: A Process Model." Journal of Applied Psychology, 63:391-407.

Turner, W. E.
1960 "Dimensions of Foreman Performance: A Factor Analysis of Criterion Measures." Journal of Applied Psychology, 44:216-223.

Vroom, Victor
1964 Work and Motivation. New York: Wiley.

Williems, E. P.
1973 "Go Ye Into All the World and Modify Behavior: An Ecologist's View." Representative Research in Social Psychology, 4:93-105.

Woodward, Joan
1965 Industrial Organization: Theory and Practice. London: Oxford University Press.